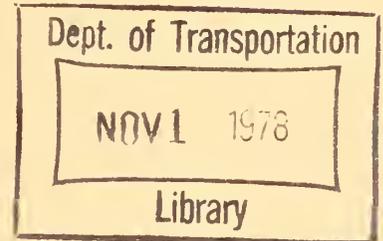


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A/TSC Transit Dependent Transportation Series

Atlanta Wheelchair Accessible Bus Study



Final Report
August 1978

Service and Methods Demonstration Program



U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration
and Transportation Systems Center

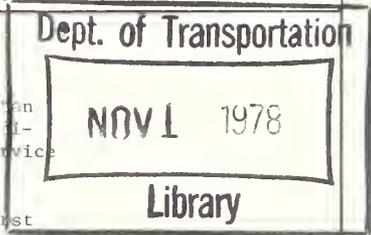
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16. Abstract					
<p>This study describes the implementation and operation of the Metropolitan Atlanta Rapid Transit Authority's fixed-route, subscription service for handicapped individuals. Operational characteristics for the early months of service are also presented.</p> <p>The subscription service, initiated in May 1977, has grown over the first year from a single bus running three daily routes to seven buses running 27 daily and two weekly routes. The buses are all lift equipped and most have 4 wheelchair positions and seventeen seats. As of May 1978 ridership had reached 270 passenger trips per week.</p> <p>New routes are established by grouping trip origin and destination requests into vehicle tours. At least four handicapped passengers must be able to be served in a single tour before that route is incorporated into the system. The dispersion of the desired trip origins and destinations has resulted in low productivities and, consequently, in high passenger trip costs. The net direct operating cost, excluding the extra deadheading due to special garaging requirements, was \$12.54 per passenger trip for the first seven weeks of service with only very slight reductions since that time.</p> <p>The major difficulty that users experience with the lift equipment has been getting onto the lift platform unaided. However, with the driver, or social service agency staff, or the passenger's family to assist them, this has not restricted their usage of the system in any way. Mechanically, the lift equipment has performed better than the Authority's maintenance staff expected.</p>					
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Preface

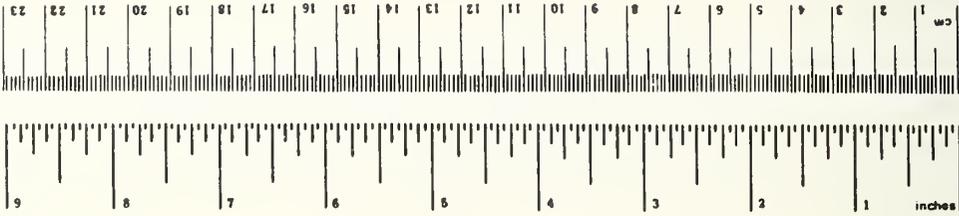
This paper, prepared for the UMTA Service and Methods Demonstration Program (PPA UM-827), is one of a series of studies of wheelchair accessible bus implementations. This paper is based on a site visit and discussions with several individuals in the Atlanta area.

The authors are particularly indebted to Mr. John Bates and Mr. Charles Daniel of the Metropolitan Atlanta Rapid Transit Authority for their time and helpfulness in supplying information for this paper. Special acknowledgement is also due to Mr. Michael Corn of the Metropolitan Atlanta Rapid Transit Authority, Mr. Joel Stone, Jr. and Ms. Bonnie Freeman of the Atlanta Regional Commission, Ms. Margie Sloan of the Rehabilitation Services Administration, Ms. Liz Bradshaw and Ms. Eleanor Smith of the Atlanta Rehabilitation Center, and Mr. Les Smith of Transportation Design and Technology, Inc., for their assistance in providing information and relevant background material.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	What You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
teaspoon	teaspoons	5	milliliters	ml
tablespoon	tablespoons	16	milliliters	ml
fluid ounce	fluid ounces	30	milliliters	ml
cup	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

What You Know	Multiply by	To Find	Symbol	
LENGTH				
millimeters	0.04	inches	in	
centimeters	0.4	inches	in	
meters	3.3	feet	ft	
meters	1.1	yards	yd	
kilometers	0.6	miles	mi	
AREA				
square centimeters	0.16	square inches	in ²	
square meters	1.2	square yards	yd ²	
square kilometers	0.4	square miles	mi ²	
hectares (10,000 m ²)	2.5	acres		
MASS (weight)				
grams	0.035	ounces	oz	
kilograms	2.2	pounds	lb	
tonnes (1000 kg)	1.1	short tons		
VOLUME				
milliliters	0.03	fluid ounces	fl oz	
liters	2.1	pints	pt	
liters	1.06	quarts	qt	
liters	0.26	gallons	gal	
cubic meters	36	cubic feet	ft ³	
cubic meters	1.3	cubic yards	yd ³	
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

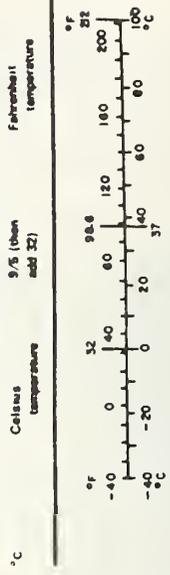


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1.0 EXECUTIVE SUMMARY

In December 1974, the Metropolitan Atlanta Rapid Transit Authority Board of Directors initiated a program to address the needs of elderly and handicapped persons in their service area. Ultimately, two special services were instituted as part of this program: (1) a special elderly group trip service for off-peak period travel for non-disabled and lesser disabled elderly persons, and (2) a special vehicle subscription, fixed route service primarily for severely handicapped people. The former went into operation on October 1, 1976; the latter on May 16, 1977.

The special vehicle service, referred to as the L-BUS, began with a single bus operating three daily routes and has slowly grown to seven buses operating 27 daily and two weekly routes. During this period ridership has increased from 41 to 270 passenger trips per week. Seventeen buses have been retrofitted with front-door wheelchair lifts although only seven are presently needed. With all the extra vehicles, equipment availability has not been a problem. Most of the buses have 4 wheelchair positions and seventeen seats.

Mechanically, the lift supplied by Transportation Design and Technology, Inc. has performed reasonably well. The MARTA maintenance staff has reported the lift performance as better than expected. Wheelchair riders, however, have had difficulty in using the lift unassisted. The majority cannot surmount the leading lift platform edge without assistance when boarding. Deboarding, however, is less difficult. The lift manufacturer has improved the design of the lift with the result that many more wheelchair riders will be able to board the bus without assistance.

L-BUS service on a per passenger basis has been expensive for MARTA to operate. Fiscal year 1977 net direct operating cost per passenger trip was \$15.95. Approximately \$3.40 of this can be attributed to the policy decision to garage and maintain all the lift buses at one location. While this may be operationally desirable, it has increased operating costs due to the extra deadhead mileage this entails. In addition to the direct operating cost, there has been a substantial management and support cost due to the extensive effort required to establish both the elderly and special vehicle services. The management and support cost will continue to increase over time but is projected to be a much smaller percentage of total cost than at present. Operating cost per passenger is projected to drop to approximately one-third of its current amount by FY79.

The principal difficulty in the operation of the service is the grouping of trip requests into tours. The scattered character of trip requests in time and space has made route development arduous. This has resulted in new routes being added very slowly and most routes carrying near the minimum number of passengers that are permitted. The low productivity is a major cause of the high passenger trip cost.

A few new trips have been made possible by L-BUS but it appears as though many trips were formerly made by another mode. However, an unmeasurable benefit to all wheelchair users is the feeling of independence made possible by the service. Many of the handicapped have expressed a preference for demand-responsive service and a less stringent trip eligibility criteria. Nevertheless, there is a sense of gratification that at least some accessible bus service is available even though its limitations are substantial.

2.0 SETTING

2.1 General Description

Atlanta, the capital of the State of Georgia, is representative of many cities in the South which are experiencing rapid growth along with an active urban renewal program. Atlanta is the industrial, commercial, and financial center of the Southeast. Some 1,800 industrial plants manufacture over 3,500 different commodities including aircraft, automobiles, furniture, textiles, chemicals, iron and steel products.

The Atlanta metropolitan area encompasses seven counties (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Rockdale) and has a population of approximately 1,652,000 persons (1975 estimate); the two largest counties are Fulton and DeKalb. The city of Atlanta is located in Fulton County. Table 2-1 shows the breakdown of the 1975 population by county, as well as the 1980 population forecasts.

TABLE 2-1. 1975 AND 1980 POPULATION BY COUNTY

County	1975 Total Population	1980 Total Population
Clayton	131,200	182,780
Cobb	249,800	328,990
DeKalb	463,600	538,390
Douglas	45,600	59,020
Fulton	618,100	677,500
Gwinnett	115,400	174,890
Rockdale	28,300	40,160
Total	1,652,000	2,001,730

During the five year period from 1975 to 1980 the overall Atlanta metropolitan population is expected to grow approximately 21%. Most of this growth, however, will take place outside the counties of Fulton and DeKalb.

2.2 Size and Geographic Distribution of the Handicapped and Elderly Population

The 1975 elderly and handicapped population estimates for each of the seven counties in the Atlanta Region are shown in Table 2-2. These estimates were developed by applying incidence rates from the 1970 census or other special studies to each county's estimated 1975 total population. Approximately 66 percent of the estimated handicapped population live in Fulton and DeKalb counties (the areas being served by the lift equipped buses). A further breakdown of the non-elderly handicapped was developed from work by Mark Battle and Associates, the Atlanta Rehabilitation Commission, the Atlanta Area Services for the Blind and the Georgia Association for the Deaf. Table 2-3 shows a stratification of this population by disability. A stratification of disability amongst the elderly was not available.

2.3 General Transportation Characteristics

2.3.1 Present Transit Service

The primary provider of transportation services in the Atlanta region is the Metropolitan Atlanta Rapid Transit Authority (MARTA). MARTA is an agency of local government created by an Act of the Georgia General Assembly in 1965. It was approved by the voters in Fulton, DeKalb, Clayton and Gwinnett Counties and the City of Atlanta in referenda the same year. The Authority officially begin its work on January 3, 1966. MARTA's initial task was to plan a

TABLE 2-2. 1975 ELDERLY AND HANDICAPPED POPULATION ESTIMATES BY COUNTY

County	Total Population	Elderly Population Age 60 & Over	Elderly Handicapped Population	Non-Elderly Handicapped Population	Total Handicapped Population
Clayton	131,200	6,298	1,197	11,713	12,910
Cobb	249,800	16,687	3,170	21,861	25,031
DeKalb	463,500	37,227	7,073	39,995	47,068
Douglas	45,600	4,619	878	3,843	4,721
Fulton	618,100	78,251	14,868	50,627	65,495
Gwinnett	115,400	10,455	1,986	9,842	11,828
Rockdale	28,300	6,515	1,233	2,044	3,282
TOTAL	1,652,000	160,052	30,410	139,925	170,335

TABLE 2-3. 1975 NON-ELDERLY POPULATION BY HANDICAP CATEGORY

HANDICAPPED, NON-ELDERLY

COUNTIES	Mentally Retarded	Visually Handicapped	HANDICAPPED, NON-ELDERLY			Total
			Confined to Wheelchair	Other Mechanical Aids	General	
Clayton	3,747	355	173	1,329	6,109	11,713
Cobb	6,993	662	324	2,480	11,402	21,861
DeKalb	12,791	1,211	592	4,536	20,865	39,995
Douglas	1,229	116	58	436	2,004	3,843
Fulton	16,196	1,533	749	5,744	26,405	50,627
Gwinnett	3,148	298	146	1,117	5,133	9,842
Rockdale	654	62	30	232	1,066	2,044
TOTAL	44,758	4,237	2,072	15,874	72,984	139,925

comprehensive bus and rail transit system for the Metropolitan Atlanta area.

After rejecting previous efforts, in November 1971 the voters of Fulton and DeKalb Counties approved a plan for improving and subsidizing existing bus service and for constructing a rapid transit system with financing to come from a one per cent local sales tax. On February 17, 1972 MARTA purchased the Atlanta Transit System, Inc. (a private bus operation) and on March 1, reduced the fare from 40¢ to 15¢ (with two free transfers) on all routes operated in Fulton and DeKalb Counties. Since then, MARTA has made numerous improvements to transit routes and schedules.

In addition to service for the general public, MARTA also provides special transportation services for the handicapped and elderly. These services, which were approved by the MARTA Board of Directors in August 1976, include a Special Elderly Service, or E-BUS, and the Special Vehicle Service, or L-BUS. Both services will be described in later sections of this report.

Table 2-4 summarizes some of the 1977 operating characteristics of the MARTA system (including the special services).

TABLE 2-4. SUMMARY OF 1977 BUS OPERATIONS

Buses:	737
Number of Routes:	127
Miles of Route (Miles of Street Occupied)	900
Miles of Route of All Lines (Including Duplications When More Than One Line Uses the Same Street):	1,825
Annual Vehicle Miles:	27,300,000
Annual Total Passengers Carried:	78,000,000

2.3.2 Future Transit Services

MARTA plans call for a 61 mile rapid transit system in DeKalb and Fulton Counties. The preliminary design of the 53 mile rapid rail and 8 mile rapid busway system began in 1973. To date the Urban Mass Transportation Administration has committed funds for construction of a 13.7 mile, 17 station "starter" rail system and the design of an additional 8.1 miles. The last portion of the initial segment, a 1.9 mile north-south line under downtown is scheduled for completion in late 1979. The full system will include 39 rail transit stations and two busway stations with over 30,000 parking spaces. The rail and busway system will be coordinated with surface bus operations that will be operating on over 1,350 miles of streets and expressways in

the two county area. The rapid rail portion of the system will include ten miles of subway with 13 stations, 16 miles of aerial lines with seven stations, and 27 miles of at-grade construction with 19 stations. The rapid busway portion of the system will consist of eight miles of at-grade line, two stations and several intermediate bus ramps.

2.4 Existing Handicapped and Elderly Transportation Services

2.4.1 MARTA Spécial Elderly Service (E-BUS)

MARTA began operation of a Special Elderly Service on October 1, 1976. The service utilizes standard buses and operates during non-peak periods. Most trips consist of service between elderly high-rise residential facilities or similar concentrations of elderly persons and a single major facility such as a regional shopping center, on a regular, recurring basis with one round trip on the day operated. Residence locations may be grouped to be served with a single bus trip in order to assure as large a load as possible. Other special routes can be established on this same basis. The fare for the service is \$0.25 per passenger each way. Transfers to and from the regular transit service are permitted. The \$0.25 fare for this special service is higher than the regular, system-wide peak fare of \$0.15 for all riders.

Between October 1, 1976 and June 30, 1977, service was provided to 35 different origin locations on a regular frequency. Some of these services were weekly, some bi-weekly, some monthly and some semi-monthly; one location was served twice-weekly. The destination for all locations served was one of several regional or community shopping centers. Summary operating statistics for the E-BUS for FY77 are shown in Table 2-5.

TABLE 2-5. FISCAL YEAR 1977 E-BUS OPERATING STATISTICS

	Average Week	Average Month	Total
Number of Days Operated	4.6	19	179
Number of Origin Points Served	13	58	521
Bus Assignments Made	12	52	470
Number of People Served	250	1,085	9,762
Passenger Trips Made	489	2,157	19,416
Revenues Collected	\$124	\$539	\$4,854
Bus Hours Utilized	46	200	1,804
Direct Operating Cost	\$679	\$2,997	\$26,492
People Served Per Origin Served			19
Passenger Trips Per Bus Assigned			41
Revenue Per Bus Assigned			\$10.33
Bus Hours Per Bus Assigned			3.8
Passengers Per Bus Hour			10.8
Revenue Per Bus Hour			\$ 2.69
Direct Operating Cost Per Bus Hour			\$14.65
Direct Operating Cost Per Passenger			\$ 1.39

2.4.2 Agency Transportation

A survey was administered by the Atlanta Regional Commission to agencies and organizations serving the handicapped and elderly in order to take an inventory of their transportation services. The survey data dealt primarily with the number and types of vehicles utilized, the persons eligible to travel on these vehicles, the service areas covered and the types of trips permitted. Questionnaires were sent to social service agencies, school systems, health departments, hospitals, departments of family and child services, training centers, residences for the elderly, and other organizations which might be involved in some way with the handicapped and/or elderly. Of the 166 questionnaires returned, 61 were from agencies which operate at least one vehicle for transporting their clients.

The survey showed that 235 vehicles were utilized in serving the clients of these 61 agencies. Vehicle types included automobiles, agency autos or station wagons, vans, buses and ambulances. Of the 235 vehicles, 69 are used for transporting the elderly and 175 for transporting the handicapped. Thirty of the handicapped vehicles are equipped for transporting individuals in wheelchairs. Table 2-6 summarizes by county the number of vehicles available to accommodate wheelchair patrons as well as the type of clientele and trip purposes accommodated.

TABLE 2-6. VEHICLES ACCOMODATING WHEELCHAIRS*

Area	Persons Confined to Wheelchairs	Vehicles Accomodating Wheelchairs	Vehicles Available to Clientele Handicapped	Vehicles Available Elderly	Vehicles Available for Trip Purpose			Other
					Health	Education	Nutrition	
Clayton Co.	173	14	14	0	2	12	0	2
Cobb Co.	324	19	17	2	4	15	0	4
DeKalb Co.	592	15	14	1	4	10	0	3
Douglas Co.	58	3	3	0	1	1	0	2
Fulton Co.	749	17	16	1	5	12	0	3
Gwinnett Co.	146	15	14	1	2	12	1	4
Rockdale Co.	30	2	2	0	1	0	0	2
Regional	2,072	30**	28	4	5	22	1	7

*Most vehicles operate in more than one county; consequently, most columns cannot be summed.

**Excludes 28 private ambulances available to region.

According to Table 2-6, there is one wheelchair accessible agency vehicle available for every 69 wheelchair confined persons in the Atlanta region; however, these vehicles are subject to operational restrictions in terms of service area, hours of operation and trip purposes allowed. The majority of the vehicles are available for education and training trips. Consequently, the remaining vehicles provide very limited and infrequent service for other types of trips.

2.4.3 Taxis

Another travel mode available to the elderly and handicapped is the taxicab. This service is well suited to the demand-responsive needs of mobility limited persons by providing door-to-door service. The service, however, is expensive and may be prohibitively high for low income persons.

3.0 WHEELCHAIR ACCESSIBLE BUS PROGRAM DEVELOPMENT

On December 24, 1974, the MARTA Board of Directors initiated a program to address the needs of elderly and handicapped persons within the MARTA service area. Four specific program areas were identified:

1. Full accessibility in the design of stations and vehicles of the rail transit system;
2. Improved convenience in use of the present bus system;
3. Evaluation of needs for mobility of persons who cannot effectively utilize the transit system because of disability; and
4. Encouragement of removal of architectural barriers in the environment outside of the transit system.

MARTA has directed its effort to the first three areas, and has formally requested its constituent local governments to take positive actions to remove barriers in the general environment.

In the spring of 1975, MARTA established an Elderly and Handicapped Advisory Committee. It was composed of one member and one alternate from each of six major functional areas (elderly, wheelchair, lower extremity mobility, upper extremity mobility, visual impairment, developmentally disabled) and a member representing the viewpoint of physical/vocational rehabilitation for several functional areas. One of the tasks the Committee undertook was a

review of MARTA standard bus specifications for accessibility. The Committee recommended a number of changes which were incorporated.

From June to August 1975 MARTA conducted a survey of travel needs of the elderly and handicapped. The survey was advertised in the news media and through the various organizations serving the elderly and handicapped. Survey forms were distributed in bulk to organizations requesting them. Persons interested in participating in the survey obtained a form directly from MARTA or through an agency. Approximately 8,000 survey forms were distributed and a total of 778 usable forms were returned. Of the usable responses, 320 were completed by elderly persons with no disability, 251 by elderly disabled persons, and 207 by non-elderly disabled persons (Table 3-1). The respondents reported a total of 5,801 weekly trips; 58 percent were made on the existing MARTA bus system and 9 percent as automobile drivers (Table 3-2). The remaining 33 percent were made by taxi, as automobile passengers, in non-MARTA buses or vans, or by other modes. Twenty-six percent of the reported weekly trips were either directly provided or paid for by some social service agency. The survey did not attempt to estimate potential or latent demand for travel, but focused on present travel needs, particularly those of severely disabled persons who could not use MARTA services and could not drive.

The survey indicated that elderly and handicapped persons should not be considered as a homogeneous group, since the travel needs are different for the non-elderly handicapped, the elderly handicapped, and the elderly non-handicapped; and that a distinction should be made in terms of the type and degree of disability. There is significant use of existing transit services by the non-disabled and less severely disabled persons whose travel patterns are served by existing MARTA routes and schedules. However, the survey disclosed the need to serve trips which are not CBD oriented (64%) and which occur during "non-peak" travel periods (75%).

Based on the results of the survey it was recommended that a program of special services, E-BUS and L-BUS, be initiated. The E-BUS Service was described in Section 2.4.1. The following sections will describe the L-BUS Service.

TABLE 3-1. NUMBER OF SURVEY RESPONDENTS AND TRIPMAKING RATES BY FUNCTIONAL DISABILITY

	Elderly	Average Weekly Trips	Non-Elderly Handicapped	Average Weekly Trips	Total Respondents	Total Average Weekly Trips
Wheelchair Users	8	5.8	29	7.1	37	6.8
Blind	48	6.8	37	10.1	85	8.3
Walking Aids	71	6.4	27	8.9	98	7.1
Arms and Hands*	29	7.2	4	7.5	33	7.3
Instability**	10	6.0	31	8.3	41	7.8
Confusion	22	6.6	62	6.3	84	6.4
Hearing	63	6.4	11	8.8	74	6.8
Not Disabled/Other	320	7.8	6	8.0	326	7.8
	571	7.3	207	8.0	778	7.5

*Impairment of upper extremities affecting ability to pull up, lift, carry, and/or hold

**Difficulty in maintaining balance, walking, or standing

SOURCE: A Program of Special Transportation Services for the Elderly and Handicapped, Metropolitan Atlanta Rapid Transit Authority, Division of Planning, June 1976.

TABLE 3-2. WEEKLY TRIP VOLUMES BY TRAVEL MODE AND FUNCTIONAL DISABILITY

Mode	Wheelchair Users		Blind		Walking Aids		Lesser Disability		Other		All	
	#	%	#	%	#	%	#	%	#	%	#	%
MARTA	0	0	406	58	352	51	1125	71	1464	57	3347	58
Auto Driver	91	36	0	0	62	9	48	3	342	13	546	9
Taxi	14	6	46	7	11	2	38	2	49	2	158	3
Auto Passenger	79	31	116	17	146	21	172	11	276	11	793	14
Non-MARTA												
Bus or Van	68	27	123	17	101	15	173	11	328	13	793	14
Other	0	0	12	2	24	3	39	2	96	4	171	3
Total	252	100	703	100	696	100	1595	100	2555	100	5801	100

SOURCE: A Program of Special Transportation Services for the Elderly and Handicapped, Metropolitan Atlanta Rapid Transit Authority, Division of Planning, June 1976.

4.0 ACCESSIBLE BUS OPERATIONS (L-BUS)

4.1 Service

On May 16, 1977, MARTA began its L-BUS service. The L-BUS service is a subscription service providing transportation primarily for severely disabled persons, particularly wheelchair users. The buses are equipped with hydraulic wheelchair lifts and operate over scheduled, regular, fixed routes providing door-to-door service for the severely handicapped and to the maximum extent feasible for lesser handicapped persons. The service requires patrons to be ready for curbside pickup at both origin and destination points. Routes are established on the basis of written or telephone requests made to MARTA according to the following priorities:

1. Trips by the severely handicapped for work and other regularly scheduled trips;
2. Trips by the severely handicapped for shopping, medical and other purposes;
3. Trips by the lesser handicapped for work and other regularly scheduled trips; and
4. Trips by the lesser handicapped persons for shopping, medical and other purposes.

It should be clearly understood that L-BUS is not a demand-responsive service. Only those trips which are repetitive at least weekly are considered for inclusion in the subscription routes.

Routes are designed so that normal in-vehicle time for any single patron will not exceed 60 minutes. At least four persons per route must be identified before a new route will be started. Routes are not operated all day nor necessarily every day but are tailored to the scheduled requirements of the priority users. Nevertheless, the schedule is virtually identical from week to week unless new passengers or routes are added. As of April 1, 1978, 15 morning routes (409 miles) and 12 evening routes (431 miles) are operated Monday through Friday and 2 midday routes (65 miles) are run once per week. The morning and evening routes are work or training/rehabilitation oriented while the midday routes are shopping trips.

Once services are initiated, the developed routes are monitored and evaluated as to ridership and performance; routes may be revised if persons requesting the service do not utilize it and/or to accommodate additional requests for

service. To date no routes have had to be cancelled as substitutes for lost riders have been found where necessary.

The fare for the L-BUS service is \$1.00 each way. Exact fare is required and is payable upon boarding. MARTA does not provide attendants. When an attendant is necessary and accompanies a patron, payment of an additional fare by the attendant is not required.

4.2 Equipment

4.2.1 Vehicles

The lift buses were converted from standard 1963 model, non-air conditioned, 35-foot transit buses. Seventeen buses have been converted so far. Seven are needed each day for operation at the present time. All seventeen buses are rotated into service. MARTA has projected a need for retrofitting a total of 29 accessible buses by 1981. Of this total, 25 will be assigned for operation with 4 spares. The conversion of the buses was accomplished entirely with MARTA employees.

The vehicles have 4 wheelchair positions and 17 other seats. The exterior of the buses are painted exactly like any other MARTA vehicle. In addition, they have the internationally recognized handicapped symbol displayed on the front and sides of the bus as shown in Figure 4-1.

4.2.2 General Floor Layout

Figure 4-2 illustrates the general floor plan for a lift bus. The typical bus has seventeen seats, four wheelchair positions and a luggage rack. The wheelchair positions are located between the rear exit door and the front wheelwells, two on each side of the coach.

Twelve of the seventeen seats are bench type seats located over the wheelwells or across the back of the bus. The individual seats are angled 45 degrees from the forward position and have armrests. Aisle clearance between the seats is at least 32 inches; however, aisle width between stanchions adjacent to the wheelchair positions is only 28 inches.

Other MARTA lift buses may have different seating arrangements or numbers of wheelchair spaces. These differences are both for testing purposes and for accommodating various group requirements.



FIGURE 4-1-1. MARTA LIFT BUS VEHICLE

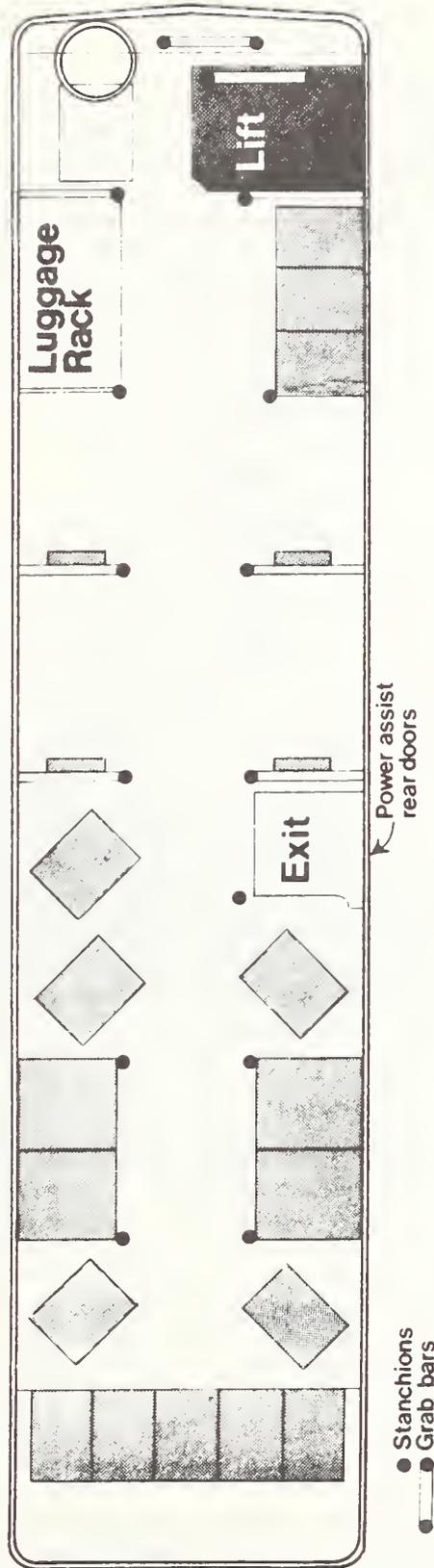


FIGURE 4-2. GENERAL FLOOR PLAN FOR LIFT BUS

4.2.3 Lift Design

The MARTA L-BUS wheelchair lift is manufactured by Transportation Design and Technology, Inc. (TDT). The lift assembly is located in the front stairwell of the bus. The unique feature of the TDT lift is the double hinged assembly which forms the vehicle entrance/exit stairs in the stowed position (Figure 4-3) and a portion of the lift platform in its lowered handicapped accessible configuration (Figure 4-4). A telescoping surface then extends beyond the platform formed by the steps and riser to complete the wheelchair ramp (Figure 4-5). At full extension the ramp projects two feet beyond the side of the bus.

4.2.4 Lift Operation

The operation of the TDT wheelchair lift is under the control of the driver at all times. The lift is hydraulically operated and electrically controlled. The primary lift control panel is mounted on the vehicle's dash to the right of the driver and behind the fare box (Figure 4-6). A duplicate control panel is also located in a box outside the vehicle just behind the front door. This secondary panel is used when driver assistance for wheelchair patrons is required outside the vehicle.

The operational sequence of the lift can best be illustrated by an example of a wheelchair patron boarding the bus. As the vehicle comes to rest at the bus stop, the doors are opened. The platform ramp extends outward to its full extension and moves to curb or street level. The lift stops when one of the pressure sensitive edges detects a fixed object. The wheelchair patron then rolls onto the lift, usually with the aid of the driver (Figure 4-7). Boarding is accomplished with the wheelchair facing either inward or outward depending on the patron's preference. Once the patron is on the lift the wheelchair brake is set and the driver then activates the safety flap. Next, the lift is raised to the bus floor. The patron unlocks the wheelchair brake, rolls off the lift platform and proceeds to the securement position. The driver returns the lift to its stair configuration and the doors can be closed. The bus is not moved from the curb until the patron is in the proper location and secured. The driver may have to assist the passenger in this activity (Figure 4-8). Deboarding a wheelchair patron is similar in operation but in the reverse sequence.

The lift operation takes approximately thirty seconds for a complete cycle. Total boarding time (including wheelchair securement) takes approximately two minutes.

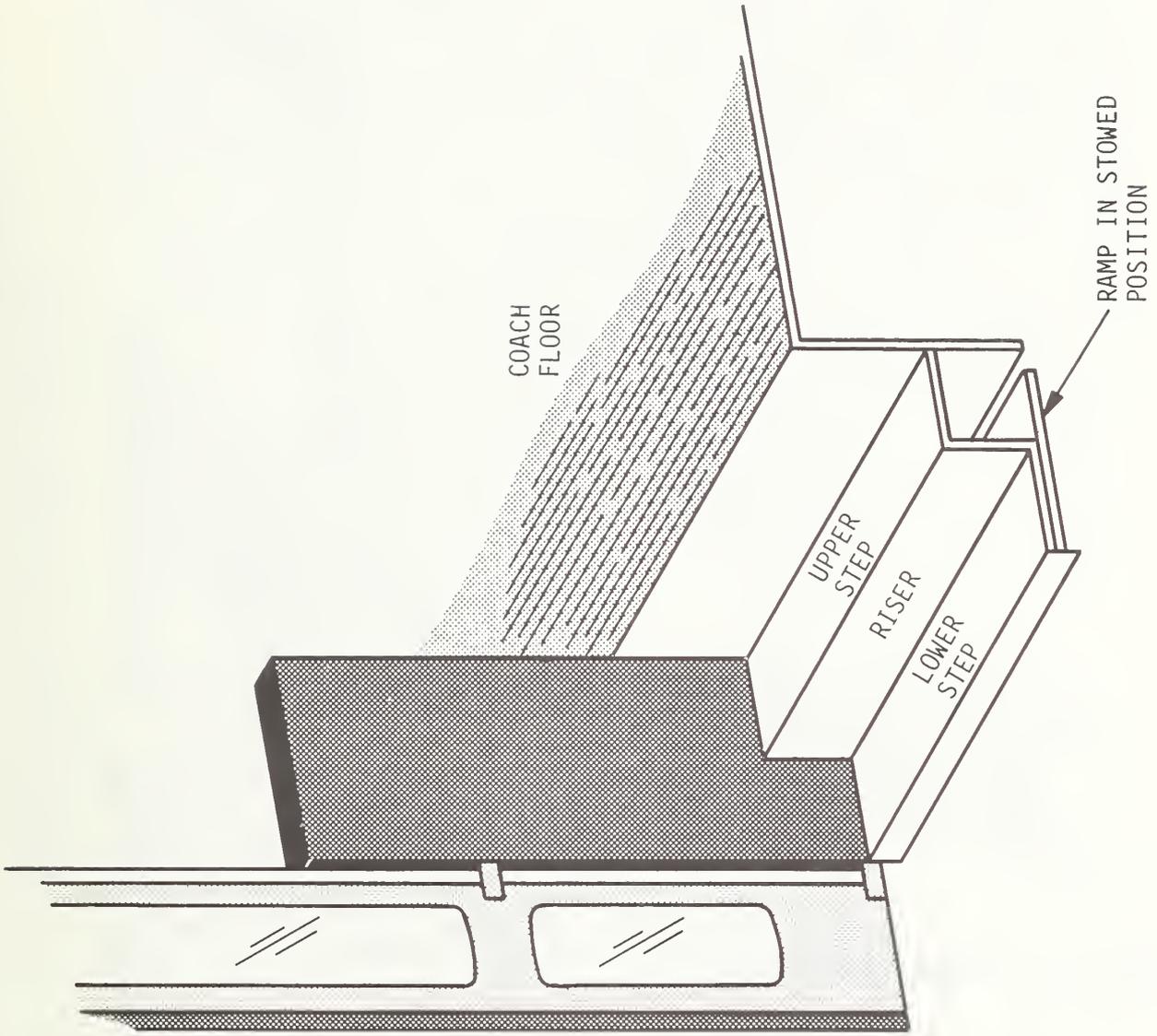


FIGURE 4-3. SKETCH OF LIFT IN STOWED/STAIR CONFIGURATION

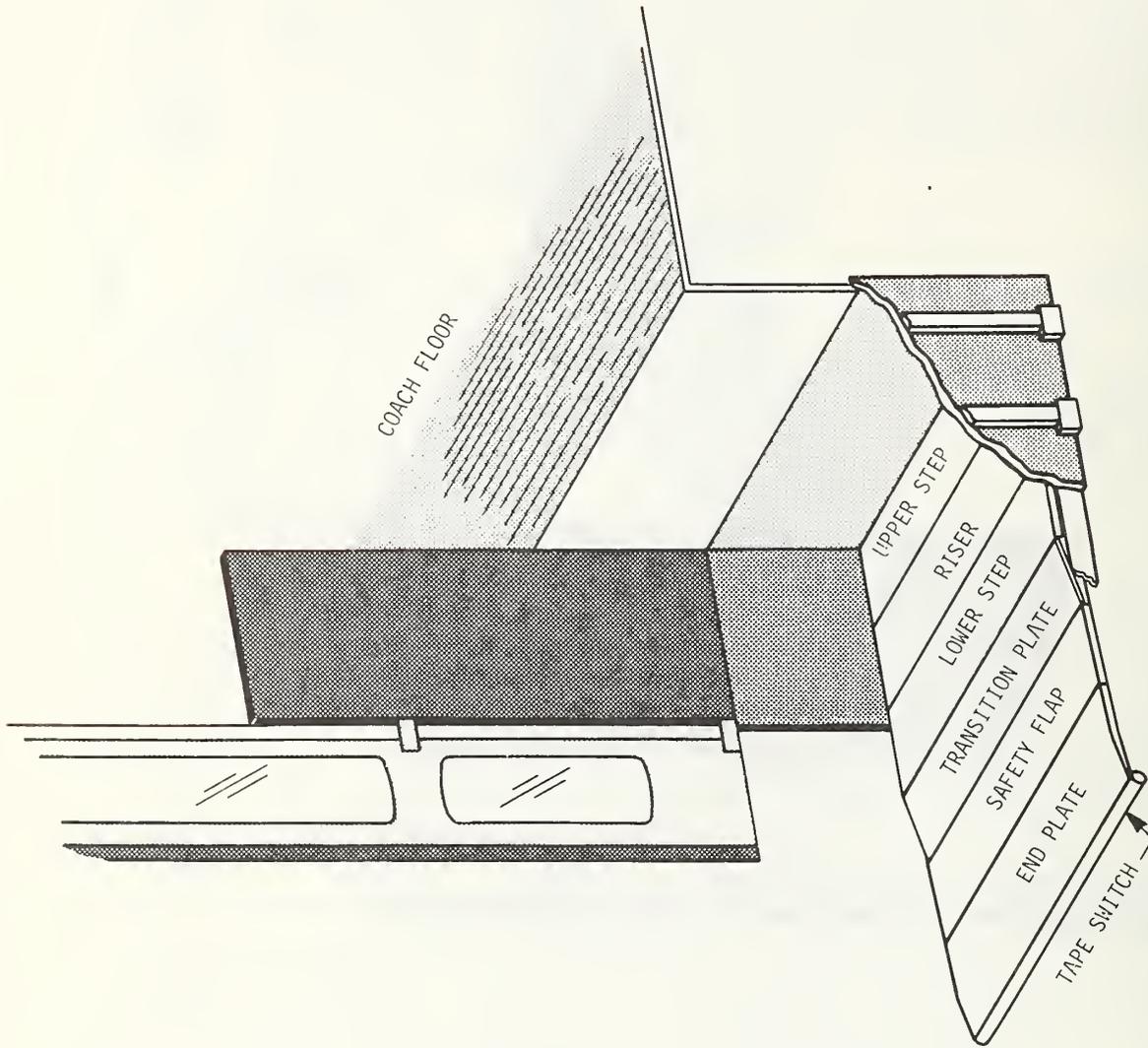


FIGURE 4-4. SKETCH OF LIFT IN LOWERED POSITION



FIGURE 4-5. LIFT PLATFORM EXTENDED WITH SAFETY FLAP RAISED



FIGURE 4-6. FAREBOX AND LIFT CONTROL PANEL LOCATION



FIGURE 4-7. MARTA DRIVER HELPING WHEELCHAIR PATRON ONTO LIFT



FIGURE 4-8. MARTA DRIVER SECURING PASSENGER WITH SEATBELT

4.2.5 Safety Features

The TDT wheelchair lift design has incorporated several necessary safety features. The lift platform and ramp are fitted with pressure sensitive tape switches along their edges. When an obstacle is encountered (e.g., the ground, curb, or a person) the lift stops automatically, thus precluding serious physical harm to persons and damage to objects or the lift. When a handicapped patron maneuvers his wheelchair onto the lift, a safety flap is activated (see Figure 4-5). The safety flap forms a barrier to prevent a wheelchair from rolling off the platform while the lift is being raised or lowered.

Other safety features include non-skid surfaces on the ramp, platform and steps, sheet metal closeout panels which prevent transit patrons from coming into direct contact with any of the lift's moving parts, and the placing of all of the lift's functions under the control of the bus driver. Whenever power is applied to the lift by activating the master control switch, the vehicle's brakes are set and the engine speed is restricted to an idle. If for some reason power, either electrical or hydraulic is lost, or the system's function interrupted, check valves inhibit the backflow of hydraulic fluid thus stopping the lift in position.

4.2.6 Wheelchair Securement

Wheelchair securement devices are necessary in order to prevent the wheelchair patron from falling out of his chair when the bus stops, starts, or negotiates corners. The principal wheelchair tiedown mechanism utilized by MARTA consists of a cushioned horizontal support bar positioned between the body wall and a vertical stanchion (Figure 4-9) together with a standard seat belt which serves to hold the wheelchair against the bar. Both the support bar, on which the back of the wheelchair rests, and the seat belt are positioned 30 inches from the floor. In addition, the wheelchair is also secured by its own brake mechanism. Figure 4-10 is a photograph showing two wheelchair patrons in their secured position.

4.2.7 Problem Areas

There are several problem areas associated with the lift design which make utilizing the lift somewhat difficult for some patrons, particularly if they are unassisted. TDT has recognized the problems and is in the process of correcting some of the design deficiencies.



FIGURE 4-9. CROSS SUPPORT BAR AND SEAT BELT



FIGURE 4-10. TWO WHEELCHAIRS IN SECURED POSITION

Among the problems noted include the difficulty for some patrons to roll onto the lift because of the thickness of the leading ramp edge (Figure 4-11). This edge contains the tape sensors which detect contact with objects in both the horizontal and vertical planes. The difficulty in making this edge thin is that the sensors must be sufficiently protected to withstand the environment. TDT is currently experimenting with a pneumatic switch as a sensitive edge and making it wedge shaped in order to help alleviate the problem.

Another difficulty involves the plate which forms the transition between the lowered step assembly and ramp extension. This plate causes an angle change in the middle of the platform and is difficult for some patrons to negotiate. The problem is compounded when the spacing of the front and rear wheels of the wheelchair is such that the front wheels touch the transition plate at the same time as the rear wheels touch the lift edge (Figure 4-12) making it extremely difficult for the patron to get on the lift.

Another difficulty is footrest clearance as the footrests of some wheelchairs hit the lift surface when boarding (Figure 4-13) or hit the pavement when debarking (Figure 4-14).

4.3 System Effects

The MARTA Lift Bus operation is a special service and is not part of MARTA's regular bus operation. Consequently, L-BUS service will not affect the operations of the regular bus system.

The total dwell time for wheelchair passengers to board the lift bus was measured to be in the range of 1 1/2 to 2 minutes. This time includes the cycle time of the lift as well as the time required for the operator to assist wheelchair patrons in boarding and to secure them in the tie down positions if necessary. Debarking a wheelchair passenger should take about the same amount of time. In scheduling the L-BUS runs, three minutes is allowed for each passenger pick-up and drop-off.

4.4 Exogenous Factors

Handicapped persons confined to wheelchairs are often faced with severe mobility barriers during the course of their daily travel. Curbs and steps are the two most prominent obstacles. Downtown Atlanta, in particular, poses a problem since a great majority of the intersections lack curb cuts and the installation of curb cuts appears to be progressing slowly. Areas which do have curb cuts appear to



FIGURE 4-11. FRONT WHEELCHAIR WHEELS ENCOUNTERING LEADING EDGE OF LIFT PLATFORM



FIGURE 4-12. WHEELCHAIR WHEELS TOUCHING LIFT EDGE AND TRANSITION PLATE AT THE SAME TIME



FIGURE 4-13. WHEELCHAIR FOOTREST STRIKING LIFT SURFACE WHEN BOARDING

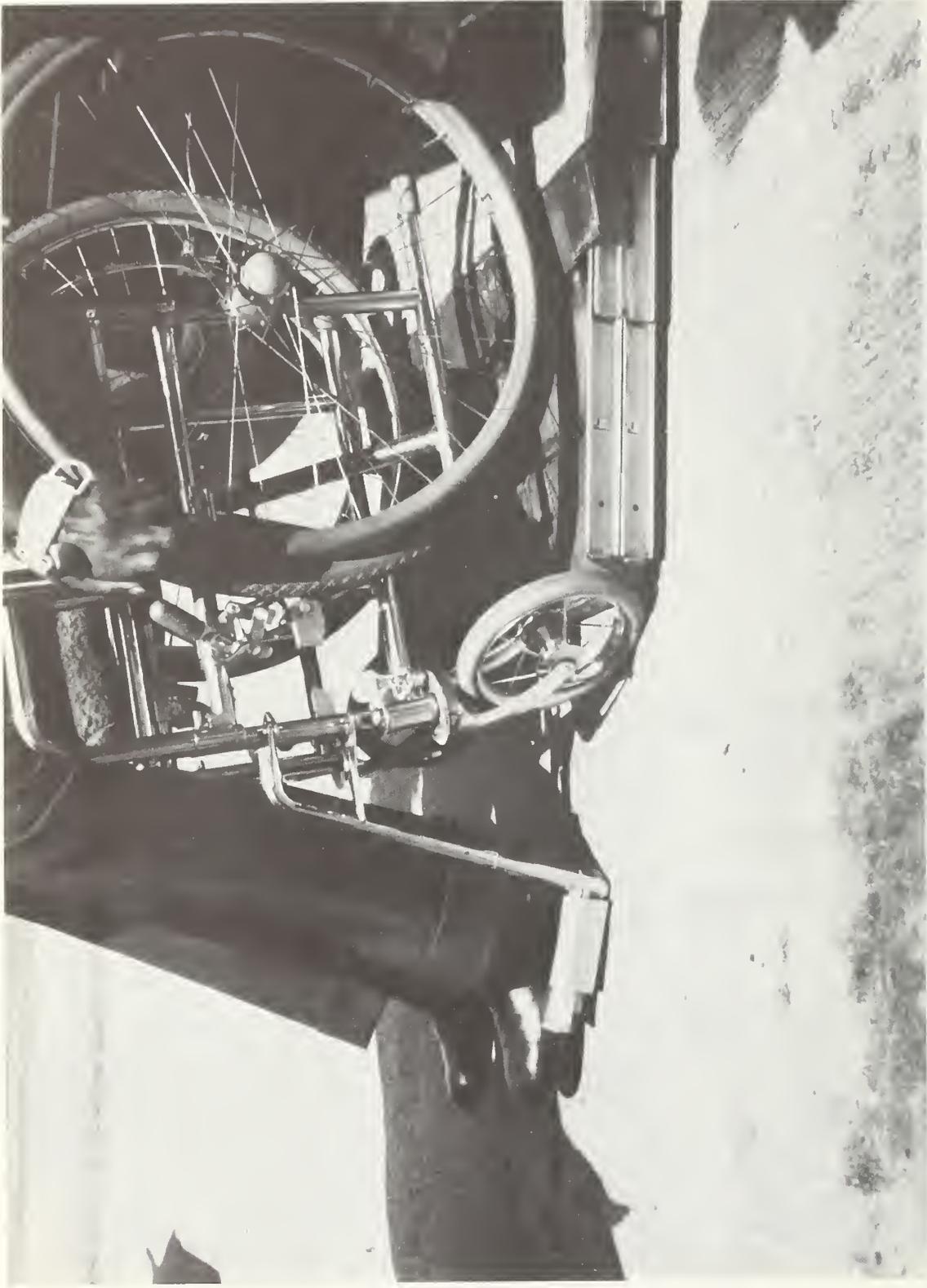


FIGURE 4-14. WHEELCHAIR FOOTREST STRIKING PAVEMENT WHEN DEBOARDING

be those which have had recent street reconstruction (due to street repairs, erection of new buildings, etc.) and even then the curb cuts may not be at all four corners of the intersection. Residential areas which have concrete curbs also lack curb cuts; those areas which do not have curbs have shoulders along the road which are usually composed of gravel and/or soft dirt. Consequently mobility by wheelchair bound persons along the streets is very limited unless accompanied by another person.

It is clear that mobility barriers in the surrounding environment will have an effect on usage of the L-BUS by the wheelchair confined. However, the door-to-door nature of the service minimizes many of these difficulties. For those without a need to move about extensively after reaching their initial destination, there should be little to prevent them from utilizing the L-BUS. Those with midday travel requirements would be less inclined to use the L-BUS. This investigation can only recognize the existence of this factor but will not be able to measure or estimate its effect.

5.0 DEMAND

MARTA initially received over 1100 separate trip requests for the L-BUS. Primarily these were for non-recurring trips. Unfortunately, the great majority of these trip requests could not be served as they did not meet the L-BUS trip eligibility criteria. New trip requests continue to be received although the rate has slowed to a trickle.

At the end of March '78, about 270 passenger trips per week were being carried on the L-BUS service, up from the 85 of the first week. Ridership climbed in steplike fashion as new routes were formed. Each new daily route would result in at least 20 added passenger trips per week due to the route formation criteria previously mentioned. In early April '78, MARTA had a file of 24 daily work or training trip requests and 180 miscellaneous trip requests (recurring though not daily) which so far they have not been able to fit into structured routes. It is particularly difficult to match miscellaneous trips due to their scatter in time and space. As a consequence, only 2 midday routes per week have been developed compared to 27 daily peak period routes. It is the difficulty in grouping trip requests into acceptable routes, and not a lack of vehicle capacity, that has been restricting the growth in L-BUS handicapped ridership. Nevertheless, MARTA is projecting a sevenfold increase in weekly riders by 1981; however, only a modest gain to 423 passengers per week is projected for 1978. The first substantial increase is predicted to occur in FY 1979.

6.0 ECONOMICS

6.1 Capital Costs

MARTA has used previously retired, 96 inch wide GM coaches for its L-BUS service. The cost of converting the buses has been \$26,434 per bus. This includes purchase and installation of the lifts, two way radios, air conditioning, new seats, stanchion relocation, painting, etc. Table 6-1 shows the cost breakdown of the retrofitting operation. All labor was performed by MARTA employees and each bus conversion took about three weeks worth of work.

TABLE 6-1. L-BUS RETROFIT COST

Materials

Lift	\$6552
Flooring	300
Seats (17)	2250
Luggage rack & Carpeting	90
Paint	224
Rear Door Controls	250
Radio	2500
Farebox	2150
Air Conditioning	7488
Wheelchair Tiedowns, Stanchions, Signal Cord, Decals and Misc.	530

Labor

4100
\$26,434

6.2 Operating Costs and Productivity

Table 6-2 presents the L-BUS FY77 operating statistics. One factor which increases the operating cost of the L-BUS is the garaging of the buses at a single location. While this is desirable from a maintenance standpoint it results in considerable extra deadheading mileage. The extra deadhead mileage adds \$3.41 to the per passenger trip cost.

TABLE 6-2. FISCAL YEAR 1977 L-BUS OPERATING STATISTICS

	Per Month Average	Per Week Average	Total
Routes Operated	123	27	184
Revenue Passengers	391	86	587
Revenue Passengers Per Route			3.2
Bus Hours Utilized	349	77	524
Revenue Passengers per Bus Hour			1.1
Direct Operating Cost	\$6,631	\$1,463	\$9,947
Direct Cost per Revenue Passenger			\$16.95
Revenue	\$ 391	\$ 86	\$ 587
Net Direct Operating Cost	\$6,240	\$1,377	\$9,360
Net Direct Cost per Revenue Passenger			\$15.95
Net Direct Cost per Revenue Passenger Excluding "Excess" Deadhead Cost			\$12.54

The FY77 net direct per passenger operating cost (excluding excess deadheading) of \$12.54 is a very high cost. It is anticipated that this figure will decrease as ridership increases. Such does not appear to have happened to date as January 1978 figures show nearly the same passenger trip costs with over three times the weekly ridership. This seems to be a result of the need to add new routes to serve new riders rather than being able to add riders to existing routes. Projections through 1982, however, do anticipate improvements in this area (Table 6-3). L-BUS passenger cost has been estimated at \$5.43 for FY79 with small increases thereafter. This has been projected to occur as a result of a productivity increase from 1.1 passengers per vehicle hour in FY77 to 3.3 in FY79 and beyond (Table 6-4). Apparently this improvement is to be achieved through extensive marketing and media advertising efforts.

There is a management and support cost in addition to the direct operating cost for the L-BUS service. MARTA has not broken down the total Special Service management and support cost between E-BUS and L-BUS and, therefore, total FY77 L-BUS service cost is not available. The FY77 support management cost for both special services was nearly double the direct operating cost. This heavy support management cost was due principally to the extra effort required for start up. After 1978, support management costs are projected to be less than one-quarter of the special service operating costs.

TABLE 6-3. COMBINED SPECIAL SERVICES BUDGET FOR FISCAL YEAR 1978
AND PROJECTIONS THROUGH FISCAL YEAR 1982

	(1977) (Actual)	1978	1979	1980	1981	1982	TOTAL
SERVICE COST (\$)							
SPECIAL ELDERLY SERVICE	(26,492)	53,472	74,380	79,622	85,155	91,146	383,775
SPECIAL VEHICLE SERVICE	(9,947)	183,810	357,600	497,640	612,053	683,592	2,334,695
SUPPORT AND MANAGEMENT	(68,021)	143,580	133,400	141,359	149,854	158,944	739,577
TOTAL	(104,460)	383,862	565,380	718,621	847,062	933,682	3,448,047
PATRONAGE (PASSENGERS)							
SPECIAL ELDERLY SERVICE	(19,416)	34,500	45,000	45,000	45,000	45,000	214,500
SPECIAL VEHICLE SERVICE	(587)	22,000	65,800	85,800	98,800	102,700	375,100
TOTAL	(20,003)	56,000	110,800	130,800	143,800	147,000	589,600
DIRECT OPERATING COST PER PASSENGER (\$)							
SPECIAL ELDERLY SERVICE	(1.36)	1.55	1.65	1.77	1.89	2.03	1.79
SPECIAL VEHICLE SERVICE	(16.95)	8.35	5.43	5.80	6.19	6.65	6.22
COMBINED SERVICES	(5.22)	6.35	5.07	5.49	5.89	6.35	6.85
VEHICLE HOURS							
SPECIAL ELDERLY SERVICE	(1,804)	3,200	4,160	4,160	4,160	4,160	19,840
SPECIAL VEHICLE SERVICE	(524)	11,000	20,000	26,000	29,900	31,200	118,100
TOTAL	(2,328)	14,200	24,160	30,160	34,060	35,360	137,940
COST PER VEHICLE HOUR	(\$44.87)	\$26.99	\$23.40	\$23.83	\$24.87	\$26.41	\$25.00

TABLE 6-4. PROJECTED L-BUS OPERATING CHARACTERISTICS
FISCAL YEARS 1978 THROUGH 1982

	(1977) (Actual)	1978	1979	1980	1981	1982
VEHICLE REQUIREMENTS						
Operating	(3)	13	17	22	25	25
Spares	(2)	4	4	3	4	4
WEEKLY VEHICLE HOURS	(77)	212	385	500	575	600
WEEKLY VEHICLE TRIPS	(27)	80	146	191	220	230
WEEKLY REVENUE PASSENGERS	(86)	423	1265	1650	1900	1975
PASSENGERS PER VEHICLE HOUR (AVERAGE)	(1.1)	2.0	3.3	3.3	3.3	3.3
PASSENGERS PER VEHICLE TRIP (AVERAGE)	(3.2)	5.3	8.6	8.6	8.6	8.6
PASSENGERS PER OPERATING BUS (AVERAGE WEEKLY)	(28.6)	32.5	74.4	75	76	79

7.0 IMPACTS

7.1 Users

For the present time, the L-BUS service offered by MARTA may not have a large impact on the mobility of handicapped persons because of the limited scope of the operation and the previously mentioned environmental barriers to wheelchair travel. There are indications from a very small sample of riders that many trips currently being made on the L-BUS replaced trips made previously by automobile (being driven by friends or relatives); however, a few new trips, i.e. trips not previously made at all, were being generated by the service. The generation of new trips will undoubtedly take time and is dependent, among other things, on service expansion and the removal of the environmental barriers which inhibit travel by handicapped persons. For trips previously made, L-BUS eliminates the need for a chauffeur and might make these trips possible at a more desirable time of day if the chauffeur had a limited availability.

Perhaps the greatest benefit provided to L-BUS users is a sense of independence; an ability to go on their own to work, to rehabilitation centers or to school. The bus trip is viewed by many of them as a positive experience.

7.2 Operator

The cost of providing L-BUS service is high and the productivity is relatively low. Since the L-BUS is a subscription service considerable management support has been required in soliciting and matching requests for service. The L-BUS service is also more expensive than regular bus operations due to the extra deadhead mileage, lift maintenance costs, special driver training for handling the lift and handicapped patrons, and L-BUS promotion and advertising.

Drivers who are potential L-BUS operators are given three hours of special training. Half of this consists of sensitivity training in the classroom on the problems of the handicapped and in how to treat handicapped patrons. A film is also shown on procedures to follow under certain medical emergencies. The rest of the training consists of instruction in the mechanical workings of the lift, operating procedures, remedial actions for correcting minor malfunctions and in helping persons in wheelchairs on and off the bus.

Drivers bid on the L-BUS routes just as they bid on any route in the system. Due to the nature of L-BUS service,

wherein most trips are in the morning and evening, drivers picking these routes either have split shifts or run regular routes to fill out their day. When regular L-BUS drivers are absent, substitutes are taken from the extras available. These substitutes are not as familiar with the handling of the lift or the handicapped riders and this can be a potential source of difficulty.

Since the Special Services are run separately from the regular routes, the L-BUS has had virtually no operational impact on other MARTA services. There are nearly three times as many lift vehicles available as are presently needed for service. Vehicle availability, therefore, has not been a problem in Atlanta as it has been at other sites. Because of this extra lift bus availability, maintenance can be accomplished during slack periods, thereby making more efficient use of maintenance personnel. Nevertheless, two extra mechanics have been hired to maintain the lift buses. The L-BUS has created the requirement for extra drivers as well. Additional personnel will be needed in the future as the number of buses used in service is increased.

8.0 ATTITUDES

8.1 Handicapped

The handicapped groups are in general pleased that a start has been made in providing a lift bus service but feel that the service is too restrictive. The most consistent opinion voiced by the handicapped is that the service should be demand-responsive rather than fixed route. Even a pre-arranged type of service (e.g., call for service the day before) would be preferable to the present system. A few also felt that the one dollar fare is expensive (particularly when compared to the 15¢ fare charged for regular service); however, most people understand that the lift bus is a premium service and are willing to accept the higher fare. Even with these reservations most individuals were pleased that a handicapped service is available and look forward to service expansion.

A common complaint of many wheelchair handicapped involves the various architectural barriers (such as steps or curbs without wheelchair ramps) which hinder them from getting around once off the buses. To this end, MARTA has formally requested its constituent local governments to take positive action in removing these barriers but is powerless to do much more.

8.2 Transit Management

MARTA is committed to the concept of providing Special Services for the handicapped and elderly and feels that the L-BUS provides better service to the handicapped than putting lifts on regular fixed route buses. What will happen in Atlanta as a consequence of the Section 504 and TRANSBUS mandates, however, remains to be seen.

The Elderly and Handicapped Advisory Committee established by MARTA is viewed as a valuable asset. Most members of this committee are handicapped or are otherwise involved with the handicapped. MARTA feels that the committee provides important inputs to the planning process and in addition calls attention to any problem areas in the operation of the service.

9.0 IMPLICATIONS FOR TRANSFERABILITY

The L-BUS operation is a subscription service utilizing full-size buses equipped with wheelchair lifts. The service is not a part of the regular route service (such as the lift bus operations in San Diego and St. Louis). It will be valuable, therefore, to compare this service with other fixed route and demand responsive services in terms of costs, coverage, productivity and level of service provided.

The costs for providing a lift bus service will be higher than regular bus service due to extra capital and operating costs. These costs will vary and will depend, among other things, on equipment, service strategies employed, and ridership levels.

Usage of fixed route or subscription fixed route lift bus service will almost certainly be low initially due to factors such as origin-destination limitations, environmental barriers, and competing services. Furthermore, it takes time for people's habits to change, particularly for those people with alternative choices for making a trip. Nevertheless, the low initial MARTA handicapped ridership has caused the per passenger trip cost to be extremely high. A key issue is whether ridership can be attracted in the amounts projected by MARTA. It is unlikely that passenger trip costs in the \$12-\$15 range will be subsidized for very long by any transit agency.

The TDT lift appears to be a good workable model. MARTA maintenance staff feel that it is working better than expected. The lift is being improved upon as more operating experience is gained in the field. Other front door lifts will soon appear on the market, but are as yet untested in

actual service. Past experience has shown that it takes time to work out the deficiencies in any new equipment.

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